UV Coating

Motivation

There are several astrophysics science questions which require improved sensitivity from 100 nm to 120 nm.

There are three ways to achieve this need:

- Better Detectors
- Larger Aperture
- Higher Coating Reflectivities

State of the Art

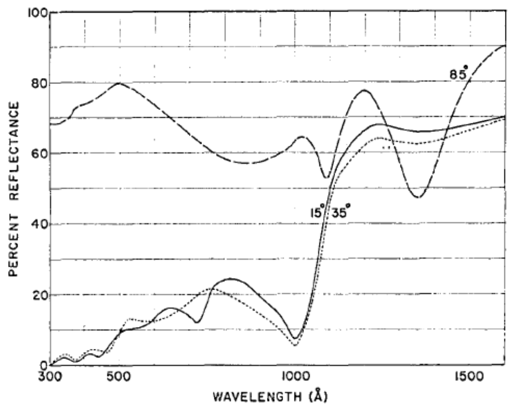

Fig. 1. Measured reflectance of an Al + MgF_2 mirror from 300 Å to 1500 Å. The MgF_2 thickness is 150 Å.

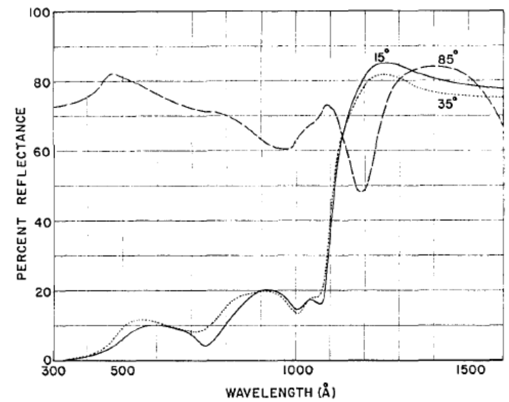

Fig. 2. Measured reflectance of an Al + MgF_2 mirror from 300 Å to 1600 Å. The MgF_2 thickness is 250 Å.

Figure C-3.3: Short Wavelength Cutoff as a function of MgF2 thickness

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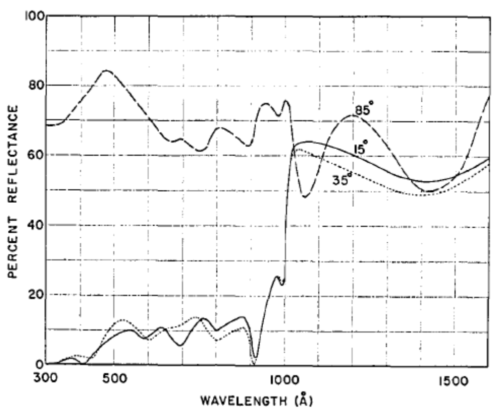


Fig. 7. Measured reflectance of an Al + LiF mirror from 300 Å to 1600 Å. The LiF thickness is 140 Å.

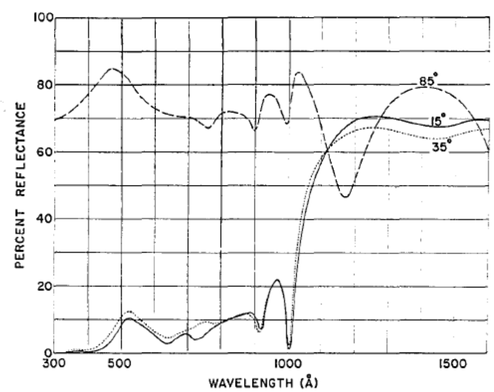


Fig. 8. Measured reflectance of an Al + LiF mirror from 300 Å to 1600 Å. The LiF thickness is 250 Å.

Figure C-3.4: Short Wavelength Cutoff as a function of LiF2 thickness.

W. R. Hunter, G. Hass, and J. F. Osantowski, “Reflectance of Aluminum Overcoated with MgF, and LiF in the Wavelength, Region from 1600 A to 300 A at Various Angles of Incidence,” Appl. Opt. 10, 3 (1971).

Study

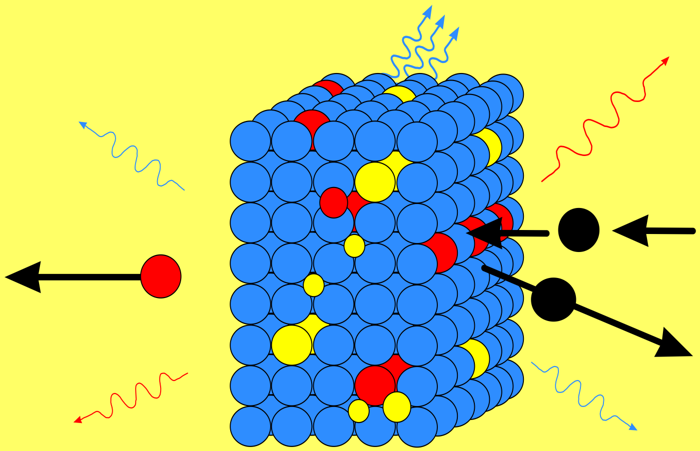
MSFC has examined several potential coating materials:

Li-Aluminum Alloy – developed for Space Shuttle and reportedly didn’t form an oxide layer.

Ga-Aluminum Alloy – reportedly very reactive to water because it does not form an oxide layer – too soft to polish.

Chemical Conversion Layer AlF Overcoat

Ultra Thin Chemical Conversion Layers For Ultra Violet Applications



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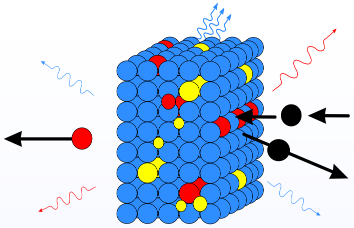
Introduction

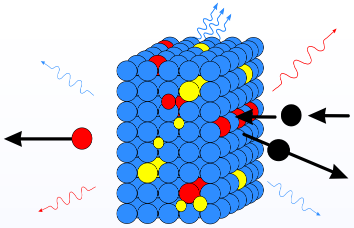
- There is a need for robust UV optical coatings with acceptable optical and mechanical properties with minimum optical absorption.

Objectives



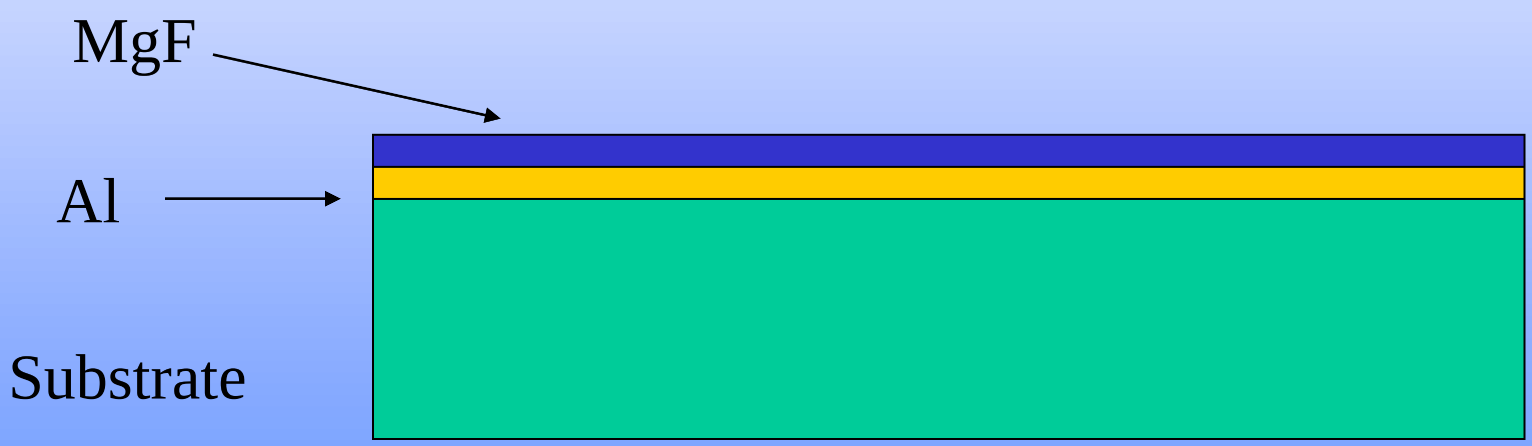
- Dense continuous layers
- Minimized absorption
- Self-limiting reaction.

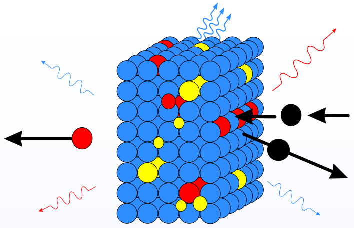
Intellectual Property



- MFS-32333-1 “Ultra Thin Protective Layer By Chemical Conversion for Vacuum Ultra-Violet Optics Applications”.
- Shapiro,Smith and Thompson

State of The Art

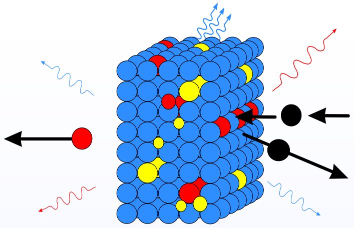




Disadvantages

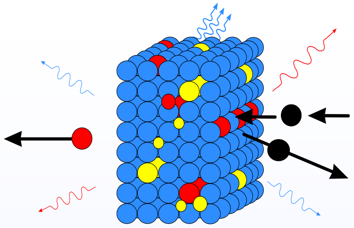
- Optical Absorption for Oxide layer
- Optical Absorption form MgF
- Poor coating integrity

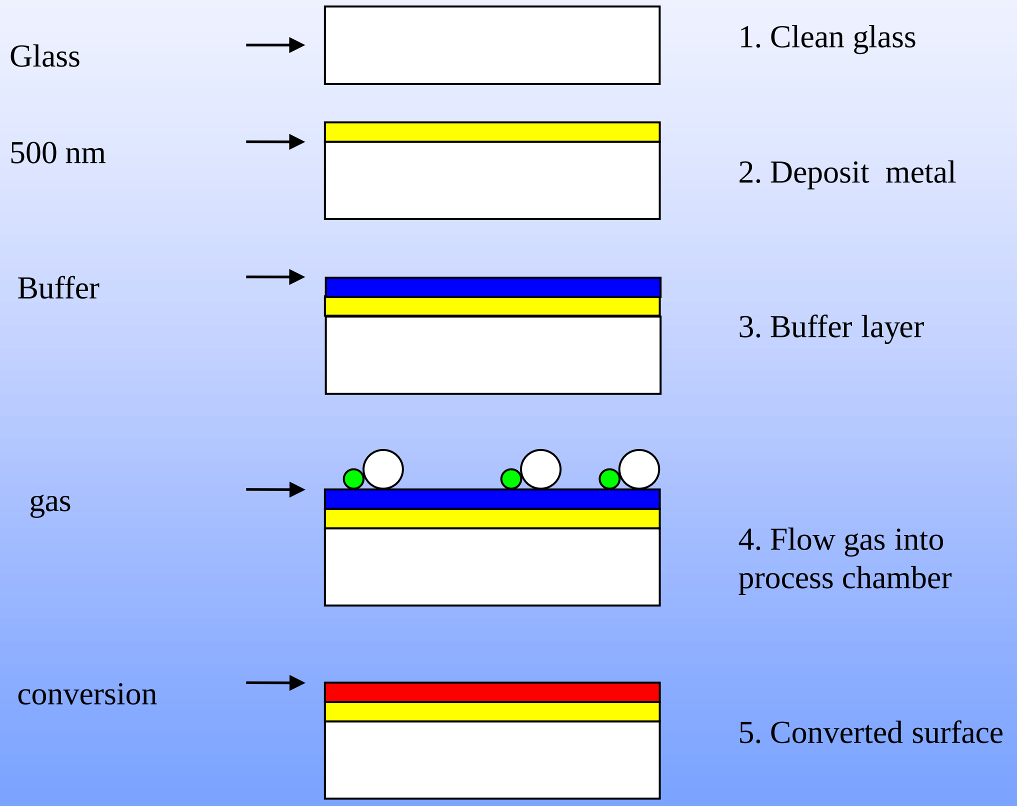
Chemical Processing



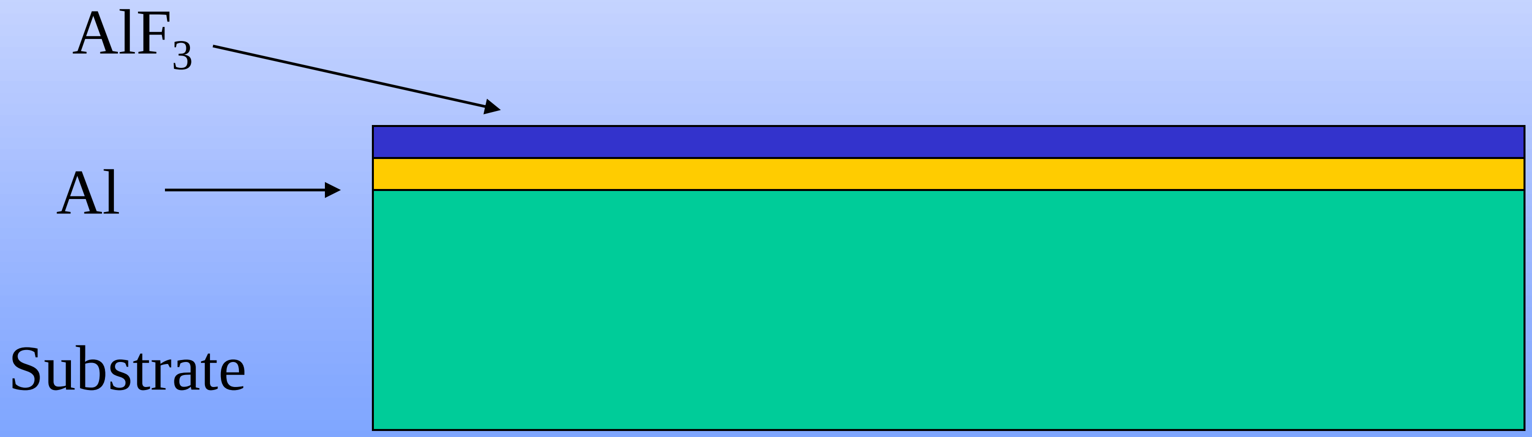
$\mathrm{Al + 6HF \rightarrow AlF3 + 3H2}$

Conversion Process

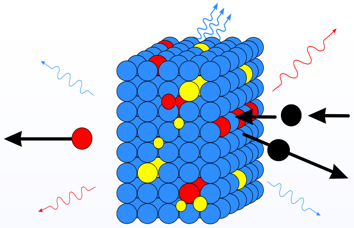




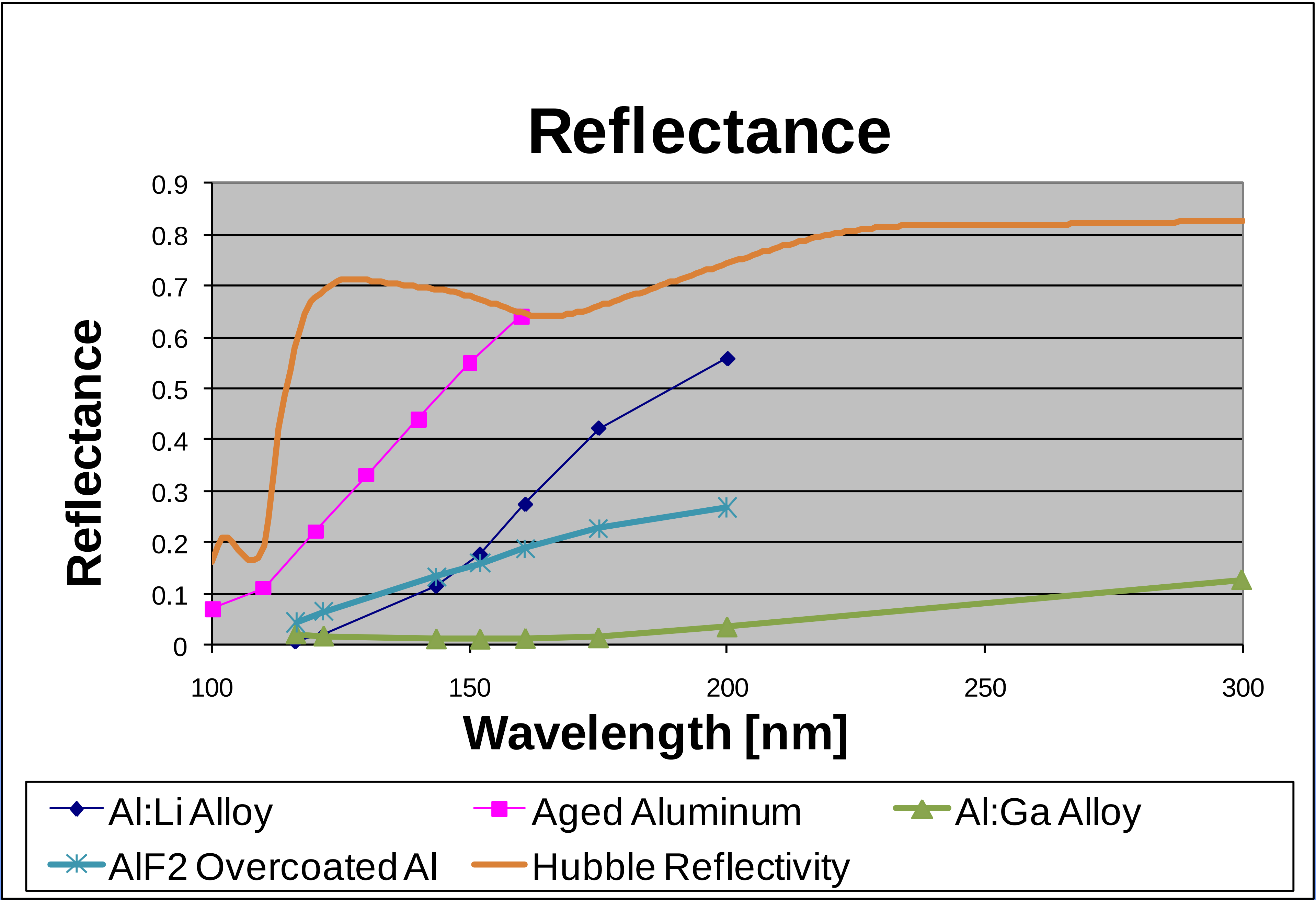
Improvement



Advantages

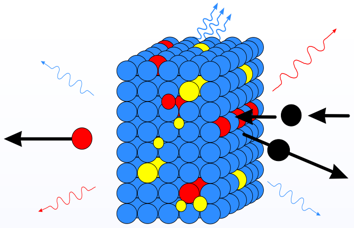


- 10 angstrom Oxide layer converts to AlF_3
- AlF_3 is on the order of 10 to 20 angstrom
- Good Coating integrity



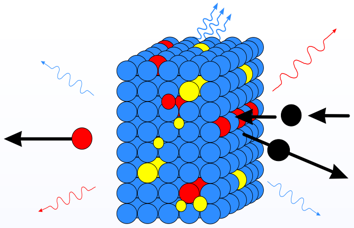
Reflectance
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
100
150
200
250
300
Reflectance
Wavelength [nm]
Al:Li Alloy
Aged Aluminum
Al:Ga Alloy
AlF2 Overcoated Al
Hubble Reflectivity

Summary

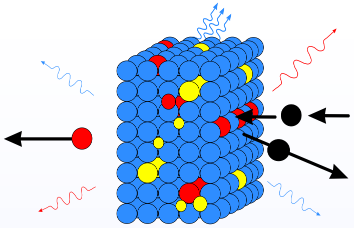


- First samples have been processed
- Samples are being tested for reflectivity

Acknowledgements



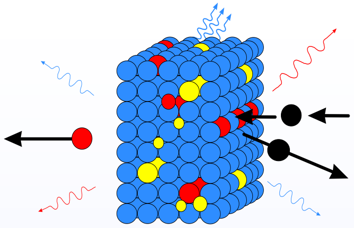
- NASA-MSFC-P. Stahl
- NASA-GSFC-R. Keski-Kuhe



END

Thank you

Initial Results



WL(NM)	sept 28 08	March 30 2009		8-Jun	
		A	B	1	2
116.2	0.007	0.018	0.025	0.039	0.047
121.6	0.019	0.014	0.021	0.058	0.07
143.5	0.115	0.011	0.013	0.12	0.145
152	0.177	0.012	0.011	0.146	0.17
160.8	0.274	0.015	0.011	0.174	0.202
175	0.422	0.018	0.01	0.212	0.241
200	0.557	0.049	0.021	0.254	0.282
300			0.126		